BTEC Assignment Brief

Qualification	Pearson BTEC International Level 3 Foundation Diploma in Applied Science Pearson BTEC International Level 3 Diploma in Applied Science Pearson BTEC International Level 3 Diploma in Biomedical Science Pearson BTEC International Level 3 Diploma in Environmental Science Pearson BTEC International Level 3 Extended Diploma in Applied Science Pearson BTEC International Level 3 Extended Diploma in Biomedical Science Pearson BTEC International Level 3 Extended Diploma in Environmental Science
Unit number and title	**Unit 20: Applications of Physical Chemistry**
Learning aim(s)	**A:** Investigate chemical thermodynamics in order to understand spontaneous reactions
Assignment title	**Chemical thermodynamics**
Assessor	
Issue date	
Hand in deadline	

Vocational Scenario or Context	You are a newly appointed chemical engineering technician working for a chemical company that specializes in making a range of chemical products. In your role you need to have a good understanding of chemical thermodynamics. When planning to carry out a new chemical reaction in the laboratory or on a manufacturing plant it is essential to have an understanding of the type of reaction to be carried out. This includes having knowledge of the balanced equation, conditions of the reaction and standard enthalpy, entropy and Gibbs energy change calculations to ascertain if the reaction is exothermic or endothermic. This understanding will support you to estimate the temperature that needs to be used to carry out the reaction safely. In your first month in your job your supervisor has set up an induction programme for you. You will need to successfully complete this induction to be able to continue as an employee of the company.

Task	As part of your induction into your new role of chemical engineering technician you are required to **investigate** enthalpy changes for two reactions and assess the quality of results. Your supervisor has also asked you to carry out **complex calculations** of enthalpy changes for a range of reactions, **explain** the concept of entropy qualitatively, **calculate** values of entropy for a range of reactions and **assess** how spontaneous reactions are using standard Gibbs energy, standard entropy and enthalpy changes. Your final portfolio will contain the following 4 sections: <u>Section 1 – The concept of entropy</u> • **Explain** qualitatively the concept of entropy in terms of

	disorder of particles and its significance for the following different chemical processes: o Changing state from solid to liquid and vice versa o Changing state from liquid to gas and vice versa o Reactions involving the increase in the number of gas molecules such as the thermal decomposition of Calcium Carbonate o Reactions involving the decrease in the number of gas molecules such as the production of ammonia o Dissolving a solid into a liquid Section 2 - Entropy and Gibbs Energy Calculations Worksheet A • Under supervision in lesson complete 'Enthalpy Change and Gibbs Energy Calculation Worksheet A'. This worksheet will enable you to: o **Calculate** a range of (at least 5) standard entropy changes for given reactions, commenting on the size and sign of the values. Interpret the size and sign of the change relating to the degree of disorder in the reactants and products. o **Assess** the spontaneity of different reactions. Calculate Gibbs energy for at least 3 reactions with different standard enthalpy change types, using standard entropy and enthalpy changes for reactants and products of the reactions. These are complex calculations and you will be expected to rearrange equations and interpret the results to determine the temperature at which each reaction becomes feasible. You will need to show all of your workings out to achieve the highest assessment criteria. Section 3 - Enthalpy Calculations Worksheet B • Under supervision in lesson, complete 'Enthalpy Calculation Worksheet B' . This will allow you to: o **explain** standard enthalpy changes for a range of different reaction types (combustion, formation, solution, hydration, neutralisation, bond dissociation, ionisation, electron affinity, atomisation, lattice, sublimation, fusion, vaporisation). For at least 5 different reaction types you will be given equations and associated enthalpy changes from which you must identify the type of standard enthalpy change that is being represented in equations and explain how this relates to the definition of that particular type of standard enthalpy change. You will also be provided with 5 reactions for which you must write equations for standard enthalpy changes. o to demonstrate that you are able to **perform** at least five complex calculations to determine standard enthalpy of reaction from enthalpy of formations and from average bond enthalpies. Use a range of data from different standard enthalpy change types. You will be expected to rearrange equations. Section 4 - Enthalpy investigations • Carry out the following investigations to **demonstrate** accurate

	measurements of enthalpy changes. You will **determine** by calculation different enthalpy changes in kJ per mole from the temperature changes you have measured for two of the following reactions: o The dissolving of anhydrous sodium carbonate in water o The dissolving of ammonium chloride in water o The neutralisation of hydrochloric acid with sodium hydroxide o The combustion of an alcohol You will need to research suitable methods to safely measure the temperature changes for these reactions and check your methods with your teacher before undertaking any practical work. • **Assess** the quality of your results by comparing your primary data against that of other new technicians on the induction programme and with literature values (secondary data) for these reactions. You will need to comment upon any differences and the extent of these differences. Consider any errors and their sources when considering the accuracy and reliability of your results. This will include any differences and assumptions in the way you have carried out your experiments and calculated your enthalpy changes. You will also need to consider the difference in the nature of reaction type and how it was conducted (e.g. neutralisation involves the reaction in direct contact with the water whilst for combustion the contact is indirect).
Checklist of evidence required	A research portfolio that includes: • An explanation of standard enthalpy changes for a range of different reactions • A demonstration of the accurate measurement of the enthalpy changes for two different reaction types. • An explanation of the concept of entropy • At least five different correct calculations of complex enthalpy changes • A range of standard entropy change calculations. • An assessment of how spontaneous reactions are by carrying out a range of calculations.

Criteria covered by this task:	
Unit/Criteria reference	To achieve the criteria, you must show that you are able to:
A.D1	Assess the spontaneity of reactions, using Gibbs energy, and the limitations of the prediction.
A.M2	Calculate entropy changes for a range of reactions.
A.M1	Perform complex calculations involving enthalpy changes, which require rearrangement.

A.P3	Explain the concept of entropy and its significance for different chemical processes.
A.P2	Demonstrate accurate determination of enthalpy changes and assess the quality of the results.
A.P1	Explain standard enthalpy changes for a range of different reaction types.
Sources of information to support you with this Assignment	All sources of information suggested are UK based. Centres are free to amend these sources to those available in the Country of delivery where more appropriate. www.edu.rsc.org.uk – Thermodynamics starters 1 and 2 (16-18); Energy in Energy out classifying reactions www.STEM.org.uk - Enthalpy changes; chemical energetics www.alevelchemistry.co.uk – Enthalpy Changes Within the copyright laws learners could search YouTube for: Thermodynamics – The laws of thermodynamics.
Other assessment materials attached to this Assignment Brief	Centres must create and internally verify their own versions of the following worksheets referred to in the Task.: 1) 'Enthalpy Change and Gibbs Energy Calculations Worksheet A' 2) 'Enthalpy Calculations Worksheet B'
Notes to the Assessor and technician	The practical activities suggested for this assignment are required to be safety checked by the Centre before use. Pearson Education can take no responsibility for the safety of any practical activities. Before doing any practical activity, you should always carry out your own risk assessment and refer to the necessary regulations. In particular, any local rules issued by your employer must be obeyed, regardless of what is suggested here. Centre should use Health and Safety information provided by a reputable source. In the UK such an example organization is CLEAPSS http://science.cleapss.org.uk/ Simple equipment will be needed to measure the temperature rise for neutralisation/making a solution: • Beakers containing known amounts of the reactants • Thermometer • Polystyrene cup with lid Simple equipment will be needed to measure the temperature rise when burning alcohols: • Spirit burners filled with various alcohols • 500cm^3 beaker filled with a known quantity of water • Cardboard to make a lid for the beaker

	• Thermometer